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OPERATING EXPERIENCE WEEKLY SUMMARY

Office of Nuclear and Facility Safety

November 6 - November 12, 1998

Summary 98-45

Operating Experience Weekly Summary 98-45

November 6 through November 12, 1998

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EVENTS

1. OPERATIONAL SAFETY REQUIREMENT VIOLATION AT OAK RIDGE

On November 6, 1998, at Oak Ridge National Laboratory, a facility manager at the Radiochem Engineering and Development Center discovered that an operational safety requirement was violated because no appropriate compensatory measures had been implemented. On October 23, technicians found one of two electric horns in the chemical makeup area inoperable during a semiannual surveillance test. The horns annunciate for a gamma radiation monitoring alarm system. Although the technicians reported the condition to the shift supervisor, no log entries or further notes were made to building supervision. Because of this oversight, no repairs were made or compensatory measures implemented for 2 weeks. (ORPS Report ORO--ORNL-X10REDC-1998-0017)

On November 6, when the technicians who had identifed the failed horn inquired about the status of the horn, the deficiency was brought to the attention of the facility manager. The manager's review of the operational safety requirement revealed that both horns are required to be functional for the alarm system to be operable, even though one horn was audible. Actions required for this type of failure include repairing/replacing the horn within 1 hour or restricting access to the area or instituting a Radiological Work Permit (RWP) so that health physics personnel can control access. After recognizing the degraded condition, the facility manager obtained an RWP specific for the condition to restrict access to personnel covered by the RWP. Maintenance personnel replaced and tested the horn and returned the alarm system to service.

Although the shift supervisor failed to log the defective equipment and communicate the condition to the next shift and appropriate repair organizations, the event shows there was a lack of administrative control regarding safety-related equipment. For example, deficiency tags or some other mechanism for tracking equipment status and implementing compensatory measures may need to be considered.

NFS reported other operational safety violations at this facility in past Weekly Summaries. Because of these violations, Oak Ridge National Laboratory management has taken a zero-tolerance position on operational safety requirement violations. Following are examples of these events.

- Weekly Summary 97-17 reported that high-efficiency particulate air filters for an exhaust system had not been tested for efficiency in accordance with surveillance requirements since October 1995. (ORPS Report ORO--ORNL-X10REDC-1997-0003)

- Weekly Summary 97-15 reported that a monthly inspection of a fire protection system was not performed as specified in the operational safety requirements because of an informal policy for establishing inspection frequencies. (ORPS Report ORO--ORNL-X10REDC-1997-0002)

OEAF engineers reviewed and reported another shift turnover error in Weekly Summary 98-10 that constituted an authorization basis violation. On March 3, 1998, at the Pantex Plant, a shift turnover error allowed an oncoming shift facility manager to authorize operations in a building cell that was in a maintenance mode from the previous shift. The facility authorization basis prohibits operations while in maintenance mode because critical safety systems may not be operable. Investigators determined that the offgoing facility manager reported the cell as being in maintenance mode to personnel in the Operations Center. However, they mistakenly marked a facility transfer sheet (used to inform oncoming facility managers of facility status) to indicate that the cell was in operation. (ORPS Report ALO-AO-MHSM-PANTEX-1998-0012)

Adherence to conduct of operations principles (such as complete and thorough communications and the need to satisfy all the requirements of the shift turnover process) is crucial for efficient, effective, and safe operations. Chapter XII, "Operations Turnover," states that shift turnover is a critical part of DOE facility operations. The Order also states that oncoming personnel should not assume operational duties until both they and the offgoing personnel have a high degree of confidence that an appropriate information transfer has taken place. Oncoming personnel should conduct a comprehensive review of appropriate written information (logs, records) and visual information (equipment, controls, status boards) before accepting responsibility for the shift. Shift turnovers should be guided by a checklist and should include a facility walk-down and a thorough review of documents describing facility status.

KEYWORDS: surveillance, test, compliance, operational safety requirement, operations

FUNCTIONAL AREAS: Licensing/Compliance, Operations

2. UNPLANNED RADIATION EXPOSURE IN EXCESS OF ADMINISTRATIVE CONTROL LIMITS

On November 5, 1998, at the Brookhaven National Laboratory Alternating Gradient Synchrotron (AGS), a worker entered the AGS ring, pictured in Figure 2-1, to look for an argon gas leak in the beam loss monitor system. The AGS was shut down when the worker entered under controlled access. When he heard the gas leak he began to look for the source. While he was pinpointing the leak, a portion of tubing came apart. He decided to reassemble the tubing. During the repair, he noticed a posting in the area indicating 7,400 mR/hr at 12". He immediately left the AGS ring and reported to a health physics technician. His self-reading dosimeter was off-scale high, indicating greater than 200 mR. The worker was forbidden to work in any radiation area until an evaluation is performed. The lack of adequate work planning resulted in the worker receiving a radiation dose that was greater than the AGS administrative control limit of 100 mR/day. (ORPS Report CH-BH-BNL-AGS-1998-0004)

A health physics technician surveyed the area where the work was performed. The survey indicated that the radiation level in the area was 5,000 mR/hr. Investigators estimate that exposure to the technician was approximately 400 mR, based on the technician's estimate of 5 minutes as the time to locate the leak and perform the repair. The personnel dosimetry group processed the technician's thermoluminescent dosimeter and determined that he received 180 mR during the incident.

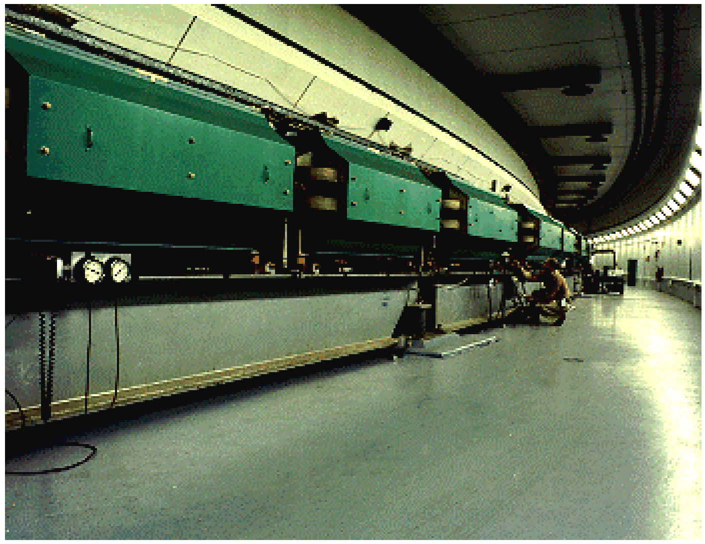

Figure 2-1. The Alternating Gradient Synchrotron

NFS has reported occurrences involving inadequate pre-job radiological surveys and the lack of work planning in Weekly Summaries 98-37 and 97-04.

- Weekly Summary 98-37 reported that a construction crew removed an 8-ton access well plug without using safety barriers, fall protection, or radiological controls coverage specified by the work permit. The access well contained contaminated equipment and materials. Investigators determined that the workers believed they were still mobilizing for a task when the lift was performed. (ORPS Report SR--WSRC-REACL-1998-0017).

- Weekly Summary 97-04 reported that a radiation control technician received an unplanned whole body radiation dose of 749 mrem and a facility operator received 535 mrem. They received the dose while conducting a contamination and radiation survey for input to a recovery work package to inspect a remote manipulator power cable. When they left the room, the technician discovered that her direct-reading dosimeter was off-scale high. Investigators determined that the technician failed to recognize trigger levels that required an As Low As Reasonably Achievable (ALARA) review and failed to have an ALARA review conducted before entry. Failure to recognize ALARA trigger levels resulted in unplanned exposures. (ORPS Report ID--LITC-WASTEMNGT-1997-0001)

These events underscore the importance of adequate work planning. They also underscore the need for adhering to radiological protection procedures. Facility managers should review the following guidance and should ensure that it is applied before beginning work.

- DOE-STD-1053-93, *Guideline to Good Practices for Control of Maintenance Activities at DOE Nuclear Facilities*, section 3.4.2, “Work Control Document,” states that maintenance should be planned, controlled by procedures, and documented.

- DOE-STD-1050-93, *Guideline to Good Practices for Planning, Scheduling, and Coordination of Maintenance at DOE Nuclear Facilities*, provides information on work controls and coordination.

- DOE/EH-0256T, *DOE Radiological Control Manual,* states that radiation exposure of the workforce and public shall be controlled such that there is no radiation exposure without commensurate benefit. Section 312, "Planning for Maintenance, Operations, and Modifications," specifies trigger levels that require formal radiological review. Appendix 3A, "Checklist for Reducing Occupational Radiation Exposure," includes the following preliminary planning and scheduling items.

  - Plan in advance
  - Delete unnecessary work
  - Determine expected radiation levels
  - Estimate collective dose
  - Sequence jobs
  - Schedule work
  - Select a trained and experienced workforce
  - Identify and coordinate resource requirements

KEYWORDS: job planning, ALARA, exposure

FUNCTIONAL AREAS: Work Planning, Radiation Protection

3. DEGRADED CIRCUIT BREAKER WIRES CAUSE ARCING AT ROCKY FLATS

On November 2, 1998, at the Rocky Flats Environmental Technology Site Analytical Operations Facility, the facility manager reported that two breaker-line wires shorted out, causing arcs. One arc occurred when machinists were restarting a fan and the other arc occurred when a stationary operating engineer shut a chiller-pump breaker. Investigators determined that the fan breaker tripped because of a loose contact that degraded the wire. They also determined that the chiller-pump breaker tripped when the wire grounded to a motor control cabinet because no grommet existed to protect the wire. The arc caused the chiller-pump breaker housing to be spot-welded to the cabinet. The shift manager initiated a work control form to repair the damage and directed electrical engineering personnel to evaluate the event. Investigators determined that the breakers had been eliminated from the preventive maintenance program approximately 10 years before because of budgetary constraints. (ORPS Report RFO--KHLL-ANALYTOPS-1998-0013)

Investigators determined that machinists had locked out and tagged out the recirculation fan, performed routine fan preventive maintenance activities, and re-energized the fan breaker to start the fan. After the fan started, the machinists heard a noise and the fan stopped. The machinists investigated and saw that the fan breaker had tripped and was smoking from an arc, so they reported it to the shift technical advisor and the shift manager. While the shift manager was investigating the event, a stationary operating engineer noticed that the chiller pump was not running and reported it to the shift manager. The stationary operating engineer and the shift manager investigated and determined that the chiller-pump breaker had tripped. Investigators determined that the chiller-pump breaker was directly above the fan breaker inside the motor control center. Because of the close proximity, the stationary operating engineer and the shift manager believed that a power surge from the fan breaker trip had caused the chiller-pump breaker to trip. After obtaining the shift manager's permission, the engineer closed the chiller-pump breaker, which caused an arc.

Facility personnel inspected the motor control center and determined that several grommets were missing. They initiated a work order to install grommets and further inspect for wire degradation. The facility manager directed facility personnel to develop a plan to include breakers in the preventive maintenance operation program. He will continue to review this event and will develop additional corrective actions as necessary.

NFS reported on predictive maintenance techniques used at commercial nuclear plants to increase reliability and extend component life in Weekly Summary 96-16. It states that maintenance departments at many commercial nuclear plants use predictive maintenance techniques to determine when preventive maintenance should be scheduled. Industry specialists have discovered that increased use of predictive maintenance techniques can improve the reliability and availability of key components while reducing overall maintenance costs. (*The Nuclear Professional*, Winter 1996)

NFS also reported inadequate predictive maintenance practices contributing to system or component failure in Weekly Summary 98-15. Some examples follow.

- Operations and maintenance personnel at the Savannah River Site In-Tank Precipitation Facility observed that an isokinetic sampler used to monitor purge exhaust radiation levels on radioactive waste storage tanks failed a weekly source check. Investigators determined that trending of performance monitoring data collected during previous weekly source checks could have been used to identify the need to recalibrate the isokinetic sampler before it could no longer perform its function. (ORPS Report SR--WSRC-ITP-1998-0002)

- Maintenance workers at Hanford discovered that one of the starting batteries for a diesel generator was dead. Investigators determined that the subcontractor mechanic did not chart the slowly diminishing specific gravity of the battery. If the subcontractor had charted this information, the battery could have been replaced before failure. (ORPS Report RL--BHI-DND-1997-0007)

- Operators at Hanford observed smoke coming from an exhaust fan. Investigators determined that a combination of poor preventive maintenance and no predictive maintenance left the motor subject to premature wear and early failure. Facility managers implemented corrective actions that included improved data collection and analysis. (ORPS Report RL--WHC-TANKFARM-1991-0140)

These events underscore the importance of implementing an effective maintenance program to ensure that facility equipment remains operable. Routine maintenance of vital equipment is necessary to ensure that the equipment can perform its intended function. These events also illustrate the importance of collecting and analyzing system and component performance data. Trending data collected during surveillances or maintenance may help predict when components or systems can no longer reliably perform their intended function. Where predictive maintenance is suitable, increased system or component availability, as well as increased safety for workers, may be achieved. Examples of predictive maintenance tools include trending the results of source checks and data collected by thermal sensing, vibration analysis, and lubricating oil analysis.

It is essential that DOE facilities comply with the policies and objectives of DOE O 4330.4B, *Maintenance Management Program*. The policy requires that structures, systems, and components important to safe operation shall be subject to a maintenance program in order to meet or exceed lifetime design requirements. Periodic inspections (such as preventive maintenance) shall be performed to determine equipment deterioration or technical obsolescence issues that could threaten performance and safety.

The following references provide guidance that maintenance planning organizations should use when developing predictive maintenance programs.

- DOE O 4330.4B, *Maintenance Management Program*, section 3.6, states that a balance of corrective and preventive maintenance will provide confidence that equipment degradation is identified and corrected, that equipment life is optimized, and that the maintenance program is cost-effective. It also states that predictive maintenance should be used to plan maintenance before equipment failures occur. Section 8.1 states that management involved in maintenance activities should ensure that maintenance practices are effective in maintaining safe and reliable facility operation.

- DOE-STD-1051-93, *Guideline to Good Practices for Maintenance Organization and Administration at DOE Nuclear Facilities*, gives examples of good maintenance practices, including predictive maintenance, developed from commercial and DOE sources.

- DOE-STD-1052-93, *Guideline to Good Practices for Types of Maintenance Activities at DOE Nuclear Facilities*, provides guidance on selection of predictive maintenance components and techniques. Section 3.4.4.1 of this standard states: "Predictive maintenance should be integrated into the overall preventive maintenance program so that 'just-in-time' planned maintenance may be performed prior to equipment failure. Not all equipment conditions and failure modes can be monitored; therefore, predictive maintenance should be selectively applied." The standard describes several predictive techniques that may be used to detect equipment degradation before failure.

- DOE-STD-1068-94, *Guideline to Good Practices for Maintenance History at DOE Nuclear Facilities*, provides maintenance organizations with information that may be used for the development and implementation of maintenance information management systems and provides critical parameters essential to conduct effective maintenance planning, data trending, and problem analysis, and to make maintenance management decisions based on maintenance history.

Reprints of the predictive maintenance article from *The Nuclear Professional*, Winter 1996, may be obtained by contacting Christine Crow at (301) 540-2396 or at christine.crow@eh.doe.gov.

KEYWORDS: maintenance, predictive maintenance, surveillance

FUNCTIONAL AREAS: Electrical Maintenance, Mechanical Maintenance, Surveillance

4. TECHNICIAN RECEIVES ELECTRICAL SHOCK AT LOS ALAMOS

On November 3, 1998, at the Los Alamos National Laboratory Firing Site, a detonation science and technology technician received an electrical shock on his left hand while preparing to work on a laser welder chiller unit. After he was shocked, he replaced the cover to the chiller unit and locked it out. He also notified the group environment, safety, and health officer and his direct line supervisor of the event. The technician believed he was not injured, so he decided not to report to the occupation medicine group. The facility manager directed the technician to report to the occupation medicine group the following day, at which time he was examined and released without any work restrictions. Investigators determined that no one had prepared a work plan or a hazards analysis for the job. (ORPS Report ALO-LA-LANL-FIRNGHELAB-1998-0008)

Investigators determined that the technician opened the chiller unit to verify component conditions before beginning work and saw a loose heat exchanger in the cabinet. He then attempted to reach for a motor to ensure it was secure when he accidentally touched something energized inside the cabinet and was shocked. Investigators believe that the technician may have touched a bus bar that was in the vicinity. They determined that the cabinet contained components that were energized to 110 and 208 V ac and that the technician opened the cabinet without de-energizing it.

The facility manager designee held a safety review meeting to discuss the event. The technician's direct line supervisor and group leader reiterated to him that he has the authority to delay work if he does not believe that it can be conducted safely. Meeting attendees scheduled a meeting with group managers to discuss the work authorization process and procedural applications associated with this equipment. They also will continue to review configuration management, procedures, training, and mentoring programs to determine if any deficiencies exist. The facility manager will develop corrective actions as necessary.

NFS reported two similar events at the Los Alamos National Laboratory Firing Site in the Weekly Summary that resulted in a safety stand-down. NFS has also reported electrical shock events in several Weekly Summaries.

- Weekly Summaries 98-36 and 98-21 reported that an electrician at the Kansas City Plant received second- and third-degree flash burns from an electrical arc blast while cleaning a 13.8-kV switch at an outdoor substation. The electrician was stunned by the arc blast and wandered in a nearby area until a maintenance team manager and two millwrights found him while investigating the cause of smoke coming from the area. The electrician received skin grafts to his right arm and left hand. A Type B Accident Investigation Board determined that the electrician did not know that the surrounding equipment was energized. Investigators identified the root cause of the event as lack of effective work integration and failure to responsibly implement the high-voltage work control process. (*Type B Accident Investigation Board Report on the May 24, 1998, Electrical Arc Blast at the Kansas City Plant*, July 1998; and ORPS Report ALO-KC-AS-KCP-1998-0010)

- Weekly Summary 97-19 reported two events where technicians at Los Alamos National Laboratory Firing Site forgot to isolate energy sources before working on systems. In the first event, a design technician was startled by an electrical arc discharge from a 15 kV dc, 500 μA photocathode in a camera. The design technician was taking measurements on the camera with calipers. In the second event, a technician received a mild electrical shock to his left hand from a 1 kV, 15 mA power supply with 3.5 J of stored energy. The technician was setting up to test electrical components. These two events, and an event reported in February by Dynamic Experimentation personnel, resulted in a safety stand-down of the responsible group. (ORPS Report ALO-LA-LANL-FIRNGHELAB-1997-0004)

- Weekly Summary 97-08 reported that a technician at the Los Alamos National Laboratory Firing Site violated a procedure and caused a capacitor to discharge three times when he began work on a high-voltage connector in an equipment rack without de-energizing it or grounding the capacitor. (ORPS Report ALO-LA-LANL-FIRNGHELAB-1997-0002)

These events underscore the importance of using an integrated approach to safety that stresses clear goals and policies, individual and management accountability and ownership, implementation of requirements and procedures, and thorough and systematic management oversight. The responsibility for ensuring adequate planning and control of work activities resides with line management. Managers should ensure that work control processes are followed and facility practices are enforced. Safety and health hazard analyses must be included in the work control process to help prevent worker injury. The hazard analysis process should include provisions for lockouts/tagouts, job-specific walk-downs, integration of work activities, and personnel protective equipment. Pre-job briefings, facility procedures, and training programs should emphasize the dangers associated with high-voltage electrical activities.

These events also demonstrate the importance of multiple engineered barriers to prevent hazardous events such as electrical shocks or discharges. Although human performance (supported by procedures, policies, memoranda, or standing orders) is a standard barrier to preventing electrical shocks and arcs, the probability of prevention can be increased by adding physical barriers such as lockouts and tagouts.

A good lockout/tagout program is an important element of an effective conduct of operations program. Lockout/tagout programs in DOE serve two functions. The first function, defined in both 29 CFR 1910, *Occupational Safety and Health Standards*, and DOE O 5480.19, *Conduct of Operations Requirements for DOE Facilities,* is to protect personnel from injury and protect equipment from damage. The second function is to provide overall control of equipment and system status. Lockouts/tagouts are typically applied during maintenance activities; however, there are many cases when lockouts/tagouts are needed for personnel safety. The standard states that an effective lockout/tagout program requires three elements: (1) all affected personnel must understand the program; (2) the program must be applied uniformly in every job; and (3) the program must be respected by every worker and supervisor.

Managers and supervisors in charge of job performance should ensure that hazards are identified and corrected. DOE facility managers should ensure that personnel understand the basics of work control practices and safety and health hazard analyses. Personnel in charge of system design changes should ensure that facility documentation, including drawings, is updated and accurate. Many references apply to this event. Following are some examples that facility managers should review to ensure they are incorporated in current facility safety programs.

- DOE O 4330.4B, *Maintenance Management Program,* chapter 6, provides guidance for preparing and using procedures and other work-related documents that contain appropriate work directions. Section 6.2 states that experience has shown that deficient procedures and failure to follow procedures are major contributors to many significant and undesirable events.

- 29 CFR 1910.333, *Selection and Use of Work Practices*, states: “When any employee is exposed to contact with parts of fixed electric equipment or circuits which have been de-energized, the circuits energizing the parts shall be locked out or tagged out.” It also states: “Safety-related work practices shall be employed to prevent electric shock or other injuries resulting from either direct or indirect electrical contacts, when work is performed near or on equipment or circuits which are or may be energized.” It also requires a qualified person to test the equipment to verify that all circuit elements and equipment parts are de-energized.

- DOE-STD-1120-98, *Integration of Environment, Safety, and Health into Facility Disposition Activities*, provides guidance for enhancing worker, public, and environmental safety. This standard supports integrated safety management system principles to guide the safe accomplishment of work activities; these principles include (1) line management responsibility for safety; (2) clear roles and responsibilities; (3) competence commensurate with responsibilities; (4) balanced priorities; (5) identification of safety standards and requirements; (6) hazard controls tailored to work being performed; and (7) operations authorization.

- DOE-STD-1073-93-Pt.1 and -Pt.2, *Guide for Operational Configuration Management Programs, Including the Adjunct Programs of Design Reconstitution and Material Condition and Aging Management*, provides guidelines and good practices for an operational configuration management program including change control and document control.

- DOE-STD-1030-96, *Guide to Good Practices for Lockouts and Tagouts*, section 1, "Introduction," states that the primary purpose of lockout/tagout programs is to protect employees from exposure to potential hazardous energy sources. This standard also states that lockout/tagout programs promote safe and efficient operations and are an important element of conduct of operations programs.

- DOE/EH-0557, Safety Notice 98-01, *Electrical Safety*, contains summaries, corrective actions, and recommendations related to electrical events. The notice concludes that personnel error was the direct cause of approximately half of all electrical occurrences, and it lists failure to de-energize equipment, failure to correctly lock and tag equipment out of service, and failure to perform zero-energy checks as major contributors to personnel error.

- DOE/EH-0540, Safety Notice 96-05, "Lockout/Tagout Programs," summarizes lockout/tagout events at DOE facilities, provides lessons learned and recommended practices, and identifies lockout/tagout program requirements.

- The *Hazard and Barrier Analysis Guide*, developed by OEAF, discusses barriers that provide controls over hazards associated with a job. Barriers may be physical barriers, procedural or administrative barriers, or human action. The reliability of barriers is important in preventing undesirable events such as shocks. The reliability of a barrier is determined by its ability to resist failure. Barriers can be imposed in parallel to provide defense-in-depth and to increase the margin of safety. The *Hazard and Barrier Analysis Guide* provides a detailed analysis for selecting optimum barriers, including a matrix that displays the effectiveness of different barriers in protecting against some common hazards.

OSHA regulations are available at http://www.osha-slc.gov/OshStd_data. Safety Notices 98-01 and 96-05 can be obtained by contacting the ES&H Information Center, (800) 473-4375, or by writing to U.S. Department of Energy, ES&H Information Center, EH-72, 19901 Germantown Rd., Germantown, MD 20874. Safety Notices are also available on the OEAF website at http://tis.eh.doe.gov:80/web/oeaf/lessons_learned/ons/ons.html. A copy of the *Hazard and Barrier Analysis Guide* is available from the ES&H Information Center, or on the Internet at http://tis.eh.doe.gov:80/web/oeaf/tools/hazbar.pdf.

KEYWORDS: electrical, work control, injury

FUNCTIONAL AREAS: Industrial Safety, Configuration Management, Hazards Analysis, Work Control

5. ACID SPILL AT SAVANNAH RIVER

On November 3, 1998, at Savannah River, a technician working in a Facilities and Services laboratory discovered a ruptured 1-liter polyethylene bottle of acid on the floor of a chemical hood. The rupture tipped the bottle on its side, splashing acid residue on the floor in front of the hood and on a countertop opposite the hood. Approximately 400 ml of acid solution remained in the bottle. Technicians immediately roped off the area and notified the safety engineer and an industrial hygienist. No personnel injury occurred; however, anyone working in or near the hood at the time of the rupture could have been seriously burned. (ORPS Report SR--WSRC-FSD-1998-0004)

Laboratory personnel cleaned up the acid spill under the direction of industrial hygienists. They transferred the remainder of the solution to another bottle and installed a vented cap. During a search for similar storage configurations, they located and vented a second bottle.

Investigators determined that the bottle, which did not have a vented cap, contained 66 percent hydrochloric acid and 34 percent nitric acid. Laboratory personnel had heated it to approximately 140 degrees, capped it, and placed it in the hood to cool down. Chemists believe that off-gassing of the acid mixture at elevated temperature built up sufficient pressure to rupture the bottle at a weak point.

OEAF engineers searched the ORPS database for all occurrence narratives containing "acid and bottle and (shatter OR ruptur* OR break)" and selected the following occurrences where bottles have ruptured because of internal pressure buildup. NFS has reported on one of them.

- At the Lawrence Livermore National Laboratory, an employee received chemical burns to his face when a plastic bottle pressurized, ruptured, and sprayed its contents. Investigators determined that the bottle originally contained hydrogen peroxide and that no one changed the label after it was emptied and a mixture of sulfuric and nitric acids was placed in it. Unaware that it contained concentrated acids, another employee added acidified hydrocarbon oil to the bottle and stored it on a laboratory bench-top overnight. The injured employee noticed that the bottle was bulging when he entered the laboratory the following day, but it ruptured and sprayed its contents before he could act. (ORPS Report SAN--LLNL-LLNL-1998-0025 and OEWS 98-18)

- At the Brookhaven National Synchrotron Light Source Facility, hazardous waste workers discovered a ruptured 1-liter glass bottle labeled "Used Nitric Acid" in a waste room. Investigators determined that the unvented bottle had accumulated pressure over time, causing it to burst. No personnel injuries occurred; however, the facility manager classified this event as a near miss based on the potential for injury. (ORPS Report CH-BH-BNL-NSLS-1996-0002)

- At the Argonne National Laboratory Advanced Photon Source Facility, a technician moving reagents between laboratories poured a partially filled 1-liter polyethylene bottle labeled "100% Nitric Acid" into a 4-liter polyethylene bottle containing a mixture of hydrochloric and hydrofluoric acids, nearly filling it. When the contents began to bubble, he capped the bottle, which then ruptured and spattered him, causing burns to his face and arms. Another employee in the area experienced eye and respiratory irritation. Investigators determined that the 1-liter bottle actually contained ethyl alcohol, contrary to the label. (ORPS Report CH-AA-ANLE-ANLEAPS-1993-0002)

- At the Los Alamos National Laboratory Radiochemical Site, two employees unpacking waste drums were lacerated by flying glass when an unvented 2-liter bottle ruptured. Each employee required seven stitches to the left hand. Investigators determined that the bottle contained a solution of Nichromix glass cleaner in sulfuric acid, a mixture commonly used to clean laboratory glassware. They also determined that both the material safety data sheet for Nichromix and the manufacturer's mixing instructions strongly warn against storing the solution in unvented containers. (ORPS Report ALO-LA-LANL-RADIOCHEM-1996-0008)

These events highlight the need for chemical workers to properly identify and understand the risks involved when working with hazardous chemicals. In facilities where hazardous chemicals are used, workers should be trained in the proper methods for handling, mixing, and storing these chemicals. Facility procedures should provide instructions concerning safe limits for mixing and chemical compatibility. It is important to keep records of the chemical types and quantities when mixing chemical wastes. Facility managers should emphasize the importance of researching all available sources of chemical safety information, particularly when performing first-time or infrequent operations.

Following are summaries of several lessons learned from these events.

- Laboratory managers must rigorously analyze experiments involving materials that are not completely characterized.

- Waste handlers cannot always predict the contents of legacy waste. Careful planning that anticipates unknown conditions can mitigate problems and provide a safer workplace.

- Managers of facilities that employ hazardous chemicals should examine their task-specific procedures, experiment safety review protocols, and chemical hazards training programs, and should strengthen them where necessary to improve worker safety.

- Chemical safety issues and lessons learned must be added to initial training programs so that they are communicated consistently to new hires or personnel transferred from other positions.

- Managers must give adequate attention to chemical handling issues. Users of chemical reagents must be informed of potential hazards and must act responsibly when making decisions about handling and disposal.

Information about chemicals, chemical hazards, and chemical safety programs can be found on the DOE Office of Environment, Safety and Health, Office of Worker Safety, Chemical Safety Program website at http://tis-hq.eh.doe.gov/web/chem_safety/. This site provides links to many sources of information, including requirements and guidelines, lessons learned, chemical safety networking, and chemical safety tools.

The following DOE and industry documents provide additional guidance for all personnel who work with chemicals and hazardous materials.

- DOE-HDBK-1100-96, *Chemical Process Hazards Analysis,* February 1996, and DOE-HDBK-1101-96, *Process Safety Management for Highly Hazardous Chemicals,* February 1996, provide guidance for DOE contractors managing facilities and processes covered by the Occupational Safety and Health Administration (OSHA) Rule for Process Safety Management of Highly Hazardous Chemicals (29 CFR 1910.119). Both handbooks are available from the DOE at http://www.doe.gov/html/techstds/standard/ standard.html.

- DOE Defense Programs Safety Information Letter, SIL 96-01, *Incidents from Chemical Reactions Due to Lack of or Failure to Follow Proper Handling Procedures,* June 1996, provides guidance to prevent these incidents.

- 29 CFR 1910.1450, *Occupational Exposure to Hazardous Chemicals in Laboratories*, provides direction on the use of chemicals, including signs and labels; spills and accidents; basic rules and procedures; and training and information. 29 CFR 1910.1450 is available from OSHA at http://www.osha-slc.gov/OshStd_data.

- National Research Council Publication ISBN 0-309-05229-7, *Prudent Practices in the Laboratory: Handling and Disposal of Chemicals,* 1995, section 7.B.3, "Collection and Storage of Waste," provides information and guidance for the accumulation and temporary storage of chemical wastes. The section also states that it is imperative to know the identity of all chemicals and understand their compatibility before mixing them. Information on how to order this book can be obtained from the National Academy Press, 2101 Constitution Ave., N.W., Washington, DC 20418, (202) 334-3313.

KEYWORDS: chemical reaction, pressurized, injury, labeling, acid

FUNCTIONAL AREAS: Materials Handling/Storage, Procedures, Research and Development

6. FALSIFIED COMPRESSED GAS CYLINDER CERTIFICATION

On October 8, 1998, the owner of Columbia Fire Protection (CFP) Company of Memphis, Tennessee, was sentenced to six months imprisonment and will pay a civil fine of $10,000 for certifying that he performed vital safety tests on compressed gas cylinders when he had not. Failure to properly conduct compressed cylinder testing can result in the use of defective cylinders to store compressed and frequently hazardous gasses. The rupture of a cylinder can result in serious personal injury, death, and property damage.

Inspectors from the Department of Transportation (DOT) Research and Special Programs Administration (RSPA) determined that CFP was not registered or approved by DOT as a cylinder retester and was incapable of performing hydrostatic tests in accordance with the requirements of the Hazardous Materials Regulations. They also determined that customers of CFP possessed numerous cylinders marked by CFP with Retester Identification Numbers (RIN) that were not authorized by DOT. The unauthorized identification numbers were RIN B423 and RIN 0987. RIN B423 was issued by RSPA to Walker Fire Protection Services, Inc. RIN 0987 has never been issued by RSPA. Compressed gas cylinders with RIN B423 that are known to have been retested by Walker Fire Protection Services, Inc., are safe for continued use. RSPA believes that any cylinder marked with RIN B423 last serviced by CFP or RIN 0987 is not in compliance with the Hazardous Materials Regulations (49 CFR Parts 171-180).

RSPA has determined that any person who has a cylinder marked with RIN B423 that was last serviced by CFP or RIN 0987 may not charge or fill the cylinder with a hazardous material without first having it inspected/retested by a DOT-authorized retest facility. Holders of filled cylinders marked with RIN B423 last serviced by CFP or RIN 0987 should ensure that the cylinders are vented (if filled with atmospheric gas) or otherwise properly and safely evacuated and purged.

Persons finding or possessing cylinders marked with RIN B423 last serviced by CFP or RIN 0987 should contact Wayne Chaney, Hazardous Materials Enforcement Specialist, Southern Region, Office of Hazardous Materials Enforcement, Research and Special Programs Administration, Department of Transportation, (404) 305-6126, fax (404) 305-6125.

DOE/EH-0527, Safety Notice 96-03, *Compressed Gas Cylinder Safety*, contains summaries, corrective actions, lessons learned, and recommendations related to compressed gas cylinder events and contains additional references. Safety Notices are available at http://tis.eh.doe.gov/web/oeaf/lessons_learned/ons/ons.html.

For more information on this article or for more information about RSPA, the URL is http://www.rspa.dot.gov.

KEYWORDS: certification, compressed gas, cylinder, hazardous material

FUNCTIONAL AREAS: Industrial Safety, Licensing/Compliance, Transportation

7. ADVERSE REACTION TO MISLABELED CLEANING CHEMICAL

On November 4, 1998, at the Weldon Spring Site Remedial Action Project, a cleaning subcontractor employee became nauseous and vomited while spraying a chemical cleaner in a restroom in the administration building. The employee exited the restroom and contacted the construction engineer. The site nurse sent the employee to the emergency room, where she was evaluated, treated, and released. Investigators determined that the spray bottle was mislabeled and contained a different cleaning product. This event is significant because mislabeled chemicals can result in improper use, leading to unexpected reactions and serious personnel injury. (ORPS Report ORO--MK-WSSRAP-1998-0040)

The employee was cleaning the restroom with the door closed, which could have affected ventilation. Also, investigators believe that the product may not have been properly diluted and was being used nearly full strength. The spray bottle was labeled “Crew,” which is a chemical manufactured by Johnson Products for cleaning toilet bowls and sinks. The label did bear the manufacturer’s warnings, but the bottle actually contained Lysol liquid cleaner.

Investigators determined that the product (Lysol) had been brought on site by a former subcontractor and was being used by the present contractor. Neither subcontractor had submitted the Material Safety Data Sheet (MSDS) for the chemical cleaner to the Project Management Contractor (PMC) for its approval. Environment, Safety and Health personnel located the product MSDS in the cleaning subcontractor’s MSDS book, but not in the PMC MSDS logbook. The Site Health and Safety Guidebook requires that contractors forward MSDSs to the PMC for all chemicals brought on site. The PMC must approve the chemicals before use. The PMC identified the following corrective actions.

- Ensure that PMC “Authorized for Use” labels are on all bottles before use.
- Reinforce the idea that if personnel suspect the contents of a container are not the same as the contents noted on the label, they should take a time-out for safety and find the answers.

- Retrain personnel on the need for proper labeling, having MSDSs on site, and knowing the physical effects of chemical use.

An event was reported in ORPS where a chemical was used without first reviewing the MSDS. On March 18, 1993, at the Hanford Site K Basins, three electricians experienced headaches and eye irritation while using an aerosol cleaner for circuit breaker maintenance. The work was performed in a switchgear room that lacked adequate ventilation. Investigators determined that the aerosol cleaner had been procured as a substitute cleaner and had arrived at the facility without the MSDS. At the time of the incident, managers obtained a copy of the MSDS, which indicated that the aerosol was a suspected carcinogen. Investigators also learned that the pre-job safety meeting focused more on the serious hazard of the high-voltage breaker and less on the ventilation and use of chemical cleaners. Corrective actions included (1) ensuring the MSDS is read and complied with before using a product; (2) ensuring the availability of the MSDS for the corresponding material/product; and (3) ensuring that materials requiring MSDSs are handled according to regulations from the point of shipment to the point of receipt.

These events illustrate the importance of maintaining up-to-date MSDSs and using only approved chemicals. The MSDS provides important safety information in the event of a spill or contact by personnel. Mislabeled or unlabeled chemicals make it difficult to immediately identify the chemical and determine a necessary course of action should an accident occur.

The following are commonsense practices for working with industrial and household chemicals.

- Read labels carefully and follow the manufacturer's instructions.

- Do not use more product than is recommended on the label (dilute to recommended concentrations).

- Use the appropriate product for the job.

- Follow safety guidelines on the label (rubber gloves, adequate ventilation, etc.).

- Never mix cleaning products as this may create poisonous fumes. For example, combining bleach and ammonia will release hydrazine, which is toxic and can ignite spontaneously.

- If a chemical must be transferred from the manufacturer's original container to another container, ensure that labeling information is transferred as well. Also, ensure the receiving container is clean, because chemical residues from prior use could react.

National Research Council Publication ISBN 0-309-05229-7, *Prudent Practices in the Laboratory: Handling and Disposal of Chemicals*, 1995, provides some commonsense guidance on chemical use, handling, and storage. The publication states that the contents of chemical containers should be properly identified. Labels should be understandable and fade-resistant and should include the following information: name, address, and telephone number of the chemical manufacturer; chemical identification of hazardous components; and the appropriate hazard warnings. Information on how to order this book can be obtained from the National Academy Press, 2101 Constitution Avenue, N.W., Washington, D.C. 20418. The book can also be ordered from most larger bookstores.

KEYWORDS: chemical, hazardous material, industrial hygiene, inhalation, storage

FUNCTIONAL AREAS: Chemistry, Materials Handling/Storage